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17364 U.S. PTO

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PATENT

Docket No.

0-010424USS(P25)

Transmittal of Provisional Application Pursuant to 37 C.F.R. § 1.53(c)

Application of David F. Diehl, Theodore Del Donno, Carla B. Dittman McBain, David M. Lee,
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For BINDER COMPOSITION FOR NON-WOVEN FABRIC

22151 U.S. PTO
60/537592

011604

Enclosed is a new provisional patent application. It includes 14 pages of text and 0 sheet(s) of drawings.

- ☐ Enclosed is an application assignment to OMNOVA Solutions, Inc. and a completed Assignment Recordation Cover Sheet.
- ☒ Enclosed is Return Receipt Postcard.
- ☒ The USPTO is authorized to charge the fee pursuant to 37 C.F.R. § 1.16(k) (\$160.00) to Deposit Account No.07-1045. Also, during the pendency of this application, please charge any fees incurred and credit any overpayments made to that same Deposit Account.
- ☒ Kindly address all correspondence relating to this application to the following address:

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OMNOVA Solutions Inc.
175 Ghent Road
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Registration Number	Telephone Number
40,139	330/376-1242
Date	
January 16, 2004	

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0-10424USS(P25)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the application of)

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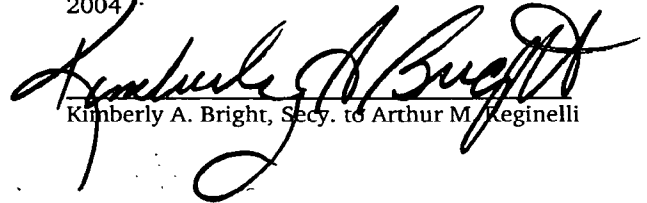
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For BINDER COMPOSITION FOR)
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Kimberly A. Bright, Secy. to Arthur M. Reginelli

TRANSMITTAL SHEET

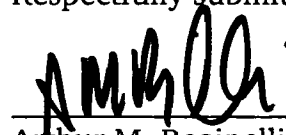
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Provisional Patent Application (14 pages)
Provisional Patent Application Transmittal Sheet
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Respectfully submitted,


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January 16, 2004

BINDER COMPOSITION FOR NON-WOVEN FABRIC

FIELD OF THE INVENTION

This invention relates to binder compositions for non-woven fabrics
5 especially permeable layer of personal hygiene articles.

BACKGROUND OF THE INVENTION

A non-woven fabric is a web or continuous sheet of fibers laid down
mechanically. The fibers may be deposited in a random manner or oriented in one
10 direction. Most widely used fibers include cellulosics, polyamides, polyesters,
polypropylene and polyethylene. The spun fibers, which may be drawn, are laid
down directly onto a belt by carding, airlaying or wet-laying. The sheet is then
bonded together with a latex binder and subsequently treated in an oven or a
calendar to complete the bonding process.

15 Commonly used lattices for non-woven fabrics are those prepared from
polymers of butadiene-styrene, butadiene-acrylonitrile, vinyl acetate, acrylic
monomers such as methyl acrylate, ethyl acrylate, methyl methacrylate and the
like. When used to bind a non-woven fabric, such as a permeable sublayer of a
personal hygiene article, the latex binder should possess several desired physical
20 properties. The desired physical properties include adequate tensile strength, a
high modulus or stiffness under certain conditions, and good textile qualities such
as tenacity, handle and the like.

SUMMARY OF THE INVENTION

25 In general the present invention provides a binder composition for a
non-woven fabric, the binder composition comprising a latex, the latex including a
heterogeneous blend of dispersed polymer particles and a surfactant, where the
particles include from about 55 to about 100% by weight of a gelled polymer, from
about 1 to about 15% by weight polymeric units bearing an acid functionality, and
30 where dried films of the latex exhibit a Tg of from about -50°C to about 60°C.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

I. General

The binder compositions are aqueous emulsions or latexes including a heterogeneous blend of dispersed polymer particles. These binder compositions preferably include at least one anionic surfactant and optionally at least one surface-active agent.

II. Polymer Characteristics

A. Tg

The polymer particles are characterized by having a Tg of from about -50°C to about 60°C, preferably from about -35°C to about 35°C, and more preferably from about -25°C to about 25°C. The Tg is typically determined based upon dried samples or films of the latex using DSC techniques.

B. Gel

The polymer particles are also characterized by having a gel content of from about 55 to about 100%, preferably from about 75 to about 95%, and more preferably from about 80 to about 90% based upon the entire weight of the particles. Gel is typically determined based on insoluble fractions within a solvent such as THF or toluene.

C. Acid Content

Further, the polymer particles are characterized by including from about 1 to about 15%, preferably from about 4 to about 12%, and more preferably from about 6 to about 11%, units bearing an acid functionality, *i.e.*, a carboxylic acid group based upon the entire weight of the polymer particles. Acid content can be determined based upon the weight of the acid bearing monomers employed in synthesizing the polymer or by FTIR techniques.

III. Polymer Composition - Qualitative

A. General

The polymer particles include monomeric units deriving from at least one soft monomer, at least one acidic monomer, and optionally at least one hard non-acidic monomer.

B. Soft Monomers

Soft monomers include those that upon polymerization give rise to elastomeric polymers or polymers having a Tg below about 0°C, preferably below about -35°C, and more preferably below about -55°C. Useful soft monomers include conjugated dienes, dimethacrylates, polyethylene glycol diacrylates, alkyl acrylates, vinyl versatate derived monomers, and mixtures thereof. Exemplary conjugated dienes include, but are not limited, 1,3-butadiene, isoprene, 1,3-pentadiene, 1,3-hexadiene, 2,3-dimethyl-1,3-butadiene, 2-ethyl-1,3-butadiene, 2-methyl-1,3-pentadiene, 3-methyl-1,3-pentadiene, 4-methyl-1,3-pentadiene, and 2,4-hexadiene.

C. Acidic Monomers

Acidic monomers include those molecules that include both a carboxylic acid group as well as a polymerizable group. These acidic monomers can include both hard and soft monomers.

Useful acidic monomers include α , β -unsaturated carboxylic acids, vinyl versatic acids, and mixtures thereof. Exemplary, α , β -unsaturated carboxylic acids include, but are not limited to, methacrylic acid, itaconic acid, citraconic acid, cinnamic acid, acrylic acid, fumaric acid, maleic acid, acids derived from anhydrides such as maleic anhydride, and mixtures thereof.

D. Optional Hard Non-Acidic Monomers

The hard non-acidic monomers include those monomers that do not include a carboxylic acid functionality and that upon polymerization give rise to thermoplastic polymers or those polymers having a Tg in excess of about 0°C, preferably in excess of about 75°C, and more preferably in excess of about 90°C. Useful hard non-acidic monomers include vinyl aromatic monomers such as styrene, α -methyl styrene, *t*-butyl styrene, alkyl substituted styrene, divinyl benzene, and mixtures thereof. Other useful hard non-acidic monomers include acrylates such as methyl methacrylate, butyl methacrylate, vinyl acetate, and mixtures thereof. Still other useful hard non-acidic monomers include acrylamides such as methyl acrylamide, 2-acrylamido-2-methylpropane sulfonic acid, the salts of this acid (e.g., sodium, potassium, or ammonium salts), and mixtures thereof.

IV. Polymer Composition - Quantitative

A. General

In order to achieve the desired polymer characteristics set forth above, the relative amounts of the various monomer employed to synthesize the polymer is preferably tailored.

B. Soft Monomer

In one embodiment, and in order to achieve the desired gel, which is caused by internal crosslinking, the polymer particles preferably include from about 75 to about 15% by weight, preferably from about 65 to about 25% by weight, and more preferably from about 60 to about 35% by weight units deriving from soft monomer, based upon the entire weight of the particle. As those skilled in the art will appreciate, the degree of gel that can be achieved is directly related to the level of polymer unsaturation. In other words, as the level of soft monomer increases, the amount of gel that can be achieved increases.

C. Hard Non-Acidic

In order to achieve the desired Tg level, the polymer particles may preferably include from about 15 to about 75% by weight, preferably from about 25 to about 65% by weight, and even more preferably from about 35 to about 60% by weight hard non-acidic monomer, based upon the entire weight of the particle, units deriving from hard non-acidic monomer. Those skilled in the art will appreciate the level of hard monomer employed in synthesizing the polymer is directly related to the Tg of the polymer. In other words, as the level of hard monomer is increased, the Tg will increase.

V. Preferred Polymer

In one particularly preferred embodiment, the polymer particles include copolymers synthesized from monomers including 1,3-butadiene, styrene, methacrylic acid, acrylic acid and optionally itaconic acid. Preferably, the polymer particles include from about 40 to about 65% by weight monomeric units deriving from 1,3-butadiene, from about 25 to about 45% by weight monomeric units deriving from styrene, from about 1 to about 8% by weight monomeric units deriving from methacrylic acid, and from about 1 to about 8% by weight monomeric units deriving from acrylic acid, based on the entire weight of the

particle. More preferably, the polymer particles include from about 45 to about 60% by weight monomeric units deriving from 1,3-butadiene, from about 30 to about 40% by weight monomeric units deriving from styrene, from about 2 to about 6% by weight monomeric units deriving from monomeric units deriving from methacrylic acid, from about 0.5 to about 3% by weight monomeric units deriving from deriving from itaconic acid, and from about 2 to about 6% by weight monomeric units deriving from acrylic acid, based on the entire weight of the particle. Even more preferably, the polymer particles include from about 48 to about 58% by weight monomeric units deriving from 1,3-butadiene, from about 32 to about 38% by weight monomeric units deriving from styrene, from about 2.5 to about 5.0% by weight monomeric units deriving from monomeric units deriving from methacrylic acid, from about 1 to about 2% by weight monomeric units deriving from deriving from itaconic acid, and from about 2.5 to about 5.0% by weight monomeric units deriving from acrylic acid, based on the entire weight of the particle.

VI. Binder Composition

A. Qualitative

The binder compositions of this invention include an aqueous emulsion or latex of the free-radical emulsion polymer described above. This aqueous emulsion optionally includes an alkali metal salt of an alkyl sulfosuccinate. Useful alkali salts of alkyl sulfosuccinates include sodium dihexyl sulfosuccinate, sodium dioctyl sulfosuccinate, sodium octane sulfonate, alkyl phenol ethoxylates, fatty alcohol ethoxylates, alkyl polyglucosides, alkyl phosphates, and mixtures thereof.

B. Quantitative

1. Surfactant

When employed within the binder composition is further characterized by including from about 0.1 to about 10% by weight, preferably from about 1 to about 6% by weight, even more preferably from about 2 to about 4% by weight of the surfactant, which is an alkali metal salt of an alky sulfosuccinate.

VII. Polymer/Emulsion Preparation

A. General

The free radical emulsion polymer utilized in this invention is prepared by employing conventional emulsion polymerization techniques such as those described in U.S. Patent Nos. 5,166,259 and 6,425,978, which are incorporated herein by reference. In general, these processes employ the use of a free-radical initiator to initiate the polymerization of monomer in the presence of a surfactant. Advantageously, this polymerization takes place in the presence of the alkali metal alkyl sulfosuccinate surfactant, which is the preferred surfactant for use in the binder composition.

B. Polymerization Techniques

Preparation of the polymers or latexes utilized in this invention is not limited to any particular emulsion polymerization technique. Accordingly, a single-charge batch polymerization process may be used, a continuous system may be used, which typically employs a CSTR, a semi-batch or continuous-feed process may be used, or an incremental process may be employed.

Polymerization is typically carried out at a temperature of about 60°C to about 80°C.

C. Initiators

Any of those free-radical emulsion polymerization initiators conventionally employed in the art may be employed in preparing the polymers or emulsion latexes of this invention. Exemplary initiators include ammonium persulfate, sodium persulfate, potassium persulfate, *tert*-butyl hydroperoxide, and di-*tert*-butyl cumene. These initiators may be used in conjunction with a reducing agent such as iron salts, amines, ascorbic acids, sodium salts of ascorbates, sodium formaldehyde sulfoxylates, and mixtures thereof. Conventional amounts of initiator and reducing agent can be used in preparing the latexes of this invention.

D. Surfactants

The surfactant employed during the polymerization process may include any of those surfactants conventionally employed in the art. As noted above, the preferred surfactant includes the alkali metal salt of an alkyl sulfosuccinate, which is the preferred surfactant for use in the binder composition. Other surfactants

that may be used in addition or in lieu of the alkali metal salt of an alkyl sulfosuccinate during polymerization include alkyl sulfates, alkyl sulfosuccinates, alkyl aryl sulfonates, α -olefin sulfonates, fatty or rosin acids salts, NPE, alkyl aryl sulfonates, alkyl phenol ethoxylates, fatty acid alcohol ethoxylates, and mixtures thereof.

Conventional amounts of the surfactant can be used in synthesizing the latex, although it may be preferred to employ the type and amount of surfactant used in the binder composition.

E. Chain Transfer Agents

Any of those chain transfer agents conventionally employed in the emulsion polymerization of conjugated diene monomers may be employed in preparing the polymers or latexes of this invention. Exemplary chain transfer agents include, alkyl mercaptans, carbon tetrachloride, carbon tetrabromide, C₂-C₂₂ n-alkyl alcohols, C₂-C₂₂ branched alcohols, 2,4-diphenyl-4-methyl-1-pentene, and mixtures thereof.

Conventional amounts of the chain transfer agent can be used in synthesizing the latex, although it may be preferred to employ the type and amount of chain transfer agent used in the binder composition.

F. Neutralizing Agents

The pH of the latex can be neutralized by the addition of a base such as potassium hydroxide, sodium bicarbonate, ammonium hydroxide, sodium hydroxide, organic amines such as triethylamine, AMP 95, and mixtures thereof.

As those skilled in the art will appreciate, it is conventional to neutralize the latex to a pH of about 4.5 to about 7.0.

G. Preferred Method

In one preferred method, the polymers or emulsions utilized in the present invention are prepared by employing an incremental polymerization technique. Even more preferably, the method includes the use of a polymer seed such as one prepared by the polymerization of itaconic acid and styrene in the presence of a suitable surfactant. Once the seeds are prepared, incremental additions of butadiene monomer, styrene monomer, and acrylic and methacrylic acid monomer, initiator, chain transfer agent, and surfactant are introduced. A

similar technique is set forth in U.S. Patent No. 6,425,978, which is incorporated herein by reference.

VIII. Binder Preparation

5 Depending on the polymerization technique employed, and more specifically the type and quantity of surfactant employed, the latex resulting from the polymerization discussed above can be employed as the binder composition. Alternatively, the alkali metal salt of the alkyl sulfosuccinate can be post added to the latex after polymerization. Likewise, the surface active agents can be post
10 added after polymerization.

IV. Use of Binder

A. General

 The binder compositions of this invention are particularly useful for
15 binding non-woven fabrics. In one embodiment, the binder can be used to bind the permeable sub-layers of personal hygiene articles such as diapers and feminine hygiene articles.

 The permeable sub-layer of the personal hygiene article is a web or mat comprised of randomly arranged non-woven fibers having an open structure and
20 high loft. The web may be formed by carding when the fibers have an appropriate length and flexibility. During carding, the crimped fibers are placed on a moving support and then treated with the binder composition.

 The fibers may include natural textile fibers such as jute, sisal, ramie, hemp, and cotton as well as many artificial organic textile fibers or filaments
25 including rayon, those of cellulose esters such as cellulose acetate, vinyl resin fibers such as those of polyvinyl chloride, copolymers of vinyl chloride with vinyl acetate, vinylidene chloride or acrylonitrile, copolymers of acrylonitrile with vinyl chloride, vinyl acetate, methacrylonitrile, vinyl pyridine, polymers and copolymers of olefins such as ethylene and propylene, also condensation polymers such as polyamides or
30 nylon types, polyesters such as ethylene glycol terephthalate polymers and the like.

 The fibers may be of one composition or mixtures of fibers in a given web. The preferred fibers include polyolefins, especially polyesters, poly(ethylene terephthalate), and acrylics, polyamides, polypropylene. The polyolefin fibers

include polypropylene, polyethylene, polybutene and their copolymers. The polyester fibers include any long chain synthetic polymer composed of at least 85% by weight of an ester of a dihydric alcohol and terephthalic acid such as polyethylene terephthalate, and, in addition liquid crystal polyesters, thermotropic polyesters and the like. The acrylic fibers include any fiber forming substance containing a long chain synthetic polymer composed of at least 85% by weight acrylonitrile units $-\text{CH}_2\text{CH}(\text{CN})-$. Other types of fibers may also be employed such as high modulus fibers more commonly known as graphite fibers made from rayon, polyacrylonitrile or petroleum pitch.

10 The fibers may be of most any suitable size and randomly arranged to most any suitable thickness depending upon the desired end use of the non-woven fabric. The fibers are typically of a length of about 0.25 to 2 inches and typically about 1.2-15 denier.

15 The fibers may be laid in an overlapping, intersecting random arrangement to a thickness of about 0.25 inches or less to form a mat of fibers. The fibers may be arranged by most any convenient known manner such as by wet laying, air-laying or carding.

B. Application Method

20 The fabric of the present invention is made by forming a mat of randomly arranged fibers. After the fibers are randomly arranged as desired, the binder compound is applied to the fibers. The latex binder is applied in an effective amount which will result in the fabric having sufficient strength and cohesiveness for the intended end use application. As well known in the art, the latex binder may be applied to the layer of randomly arranged fibers in a spaced, 25 intermittent pattern of binder sites, or uniformly applied throughout the layer of fibers. The exact amount of the latex binder employed depends, in part, upon factors such as the type of fiber, weight of fibrous layer, nature of latex binder and the like. For example, end uses that require a stronger fabric may utilize more binder. A typical content of latex binder applied on a fiber mat is about 15-40 wt 30 %. It is preferred that the minimum amount of latex binder be applied to obtain the desired required physical properties of the non-woven fabric such as tensile, hand and the like as well known in the art.

C. Curing

The latex is then cured using methods well known in the art such as by application of heat or radiation. The term "cured" refers to the latex being cross-linked to increase the tensile strength properties. The curing of the treated fibers is affected at a temperature above the glass transition temperature of the binder.

In order to demonstrate the practice of the present invention, the following examples have been prepared and tested. The examples should not, however, be viewed as limiting the scope of the invention. The claims will serve to define the invention.

EXAMPLES

Example 1

A batch reactor was initially charged with 73.4 parts by weight of the ionized water, 1.5 parts by weight of itaconic acid, an iron scavenger (EDTA), 4.2 parts by weight sodium dialkyl sulfosuccinate (a blend of about 90% by weight dihexyl and about 10% by weight dioctyl), and 3.5 parts by weight styrene.

About 0.45 parts by weight sodium persulfate and about 4.05 parts by weight deionized water were then added to the reactor. The reactor was then evacuated with a vacuum, purged with nitrogen, and maintained at about 150°F for about 30 minutes.

About 37.6 parts by weight additional styrene, about 48.5 parts by weight butadiene, about 4.8 parts by weight acrylic acid, about 4 parts by weight methyl acrylic acid, and about 1 part by weight chain transfer agent were sequentially added to the reactor in various increments over the course of about 6 hours. The resulting polymer had a theoretical solids content of about 50.5% by weight, a theoretical glass transition temperature (T_g) of -17.9, an acid content of about 10.26 weight percent, and a gel content of about 73.2%.

The resulting latex binder was then applied to polyester fibers. After applying a latex binder to the non-woven fibers, the latex binder was oven dried at about 100°C to bond the fibers and then cured at about 150°C to form a dimensionally stable non-woven fabric.

Various modifications and alterations that do not depart from the scope and spirit of this invention will become apparent to those skilled in the art. This invention is not to be duly limited to the illustrative embodiments set forth herein.

CLAIMS

What is claimed is:

1. A binder composition for a non-woven fabric, the binder composition comprising:
 - 5 a latex, the latex including a heterogeneous blend of dispersed polymer particles and a surfactant, where the particles include from about 55 to about 100% by weight of a gelled polymer, from about 1 to about 15% by weight polymeric units bearing an acid functionality, and where dried films of the latex exhibit a Tg of from about -50°C to about 60°C.
- 10 2. The binder composition of claim 1, where the polymer particles includes from about 75 to about 95% by weight of a gelled polymer.
3. The binder composition of claim 2, where the polymer particles include from
15 about 80 to about 93% by weight of a gelled polymer.
4. The binder composition of claims 1 and 2, where the polymer particles include from about 3 to about 12% by weight polymeric units bearing an acid functionality.
- 20 5. The binder composition of claims 1 and 3, where the polymer particles include from about 4 to about 11% by weight polymeric units bearing an acid functionality.
- 25 6. The binder composition of claims 1, 2, and 4, where dried films of the latex exhibit a Tg of from about -35°C to about 35°C.
7. The binder composition of claims 1, 3, and 5, where dried films of the latex exhibit a Tg of from about -35°C to about 35°C.
- 30 8. The binder composition of claims 1, 2, 4, and 6, where the gelled polymer includes from about 15 to about 75% by weight units deriving from conjugated diene monomer.

9. The binder composition of claims 1, 3, 5, and 7, where the gelled polymer includes from about 25 to about 65% by weight units deriving from conjugated diene monomer.

5

10. The binder composition of claim 9, where the gelled polymer includes from about 35 to about 60% by weight units deriving from at least one of conjugated diene monomers.

10 11. The binder composition of claims 8, 9, and 10, where the conjugated diene monomer is 1,3-butadiene.

12. The binder composition of claims 1, 4, and 5, where the polymeric units bearing an acid functionality derive from acrylic acid, methacrylic acid, itaconic acid, or mixtures thereof.

15

13. The binder composition of claim 12, where the polymeric units bearing an acid functionality comprise from about 0 to about 3% by weight units deriving from itaconic acid, from about 2 to about 7% by weight units deriving from acrylic acid, and from about 1 to about 6% by weight units deriving from methacrylic acid.

20

14. The binder composition of claim 13, where the polymeric units bearing an acid functionality comprise from about 1 to about 2% by weight units deriving from itaconic acid, from about 4 to about 6% by weight units deriving from acrylic acid, and from about 3 to about 5% by weight units deriving from methacrylic acid.

25

15. The binder composition of claim 1, where the surfactant includes an alkali metal salt of an alkyl sulfosuccinate.

30

16. The binder composition of claim 15, where the alkali metal salt of an alkyl sulfosuccinate includes alkali metal salts of mono and dialkyl sulfosuccinates, and where the alkyl substituents include from about 5 to about 12 carbon atoms.
- 5 17. The binder composition of claim 16, where the alkyl substituents of the sulfosuccinate includes from about 6 to about 8 carbon atoms.
18. The binder composition of claim 17, where the surfactant includes from about 50 to about 99% by weight sodium dihexyl sulfosuccinate compounds and
10 from about 1 to about 50% by weight sodium dioctyl sulfosuccinate compounds.
19. The binder composition of claims 1, 15, and 18, where the latex composition includes from about 1 to about 6% by weight surfactant.
- 15 20. The binder composition of claim 19, where the latex composition includes from about 2 to about 4% by weight surfactant.
21. The binder composition of claims 1, 6, and 7, where the polymer particles include from about 15 to about 75% by weight units deriving from styrene.
20
22. The binder composition of claim 21, where the polymer particles include from about 25 to about 65% by weight units deriving from styrene.
23. The binder composition of claim 22, where the polymer particles include
25 from about 35 to about 45% by weight units deriving from styrene.
24. A non-woven fabric bound with the binder composition of claim 1.
25. A diaper sub-layer comprising a non-woven fabric bound with the binder
30 composition of claim 1.